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Archaeological land evaluation

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Chapter 7

Testing the evaluation results

Conclusions and Recommendations

7.1 Introduction

In this final chapter, the land evaluation results for the Salento Isthmus and the Agro Pontino that were presented in the fifth chapter are tested against the available archaeological data and the botanical data procured in this study (see chapter 6 on the palynology of the Pontine region)¹. Applying the land evaluation method described in the second chapter, the landforms of the three study areas (2.2.2 and chapter 3) were classified as suitable, marginally suitable or unsuitable for specific kinds of agriculture (chapter 4) during a specific archaeological period (the Bronze Age, the Iron Age or the Archaic/Roman Age).

A landform was classified to be *suitable* for a particular LUT (land use type: for instance the cultivation of emmer wheat; 2.2.1), if the LUT could be implemented without difficulty, for example without additional land improvement techniques (such as drainage systems). The suitability depends on the land use requirements of the land use type and the land characteristics (2.1.2 and 2.2.2.4) of the landform.

A landform was classified to be *marginally suitable* for a certain LUT when soil improvement methods were necessary. For example a steep slope is judged unsuitable for olive cultivation, due to the risk of soil loss caused by surface runoff. But by building terraces on the flanks of the slope the suitability would have increased. But it also is well known that terrace maintenance costs were high, so the landforms in principle remained marginally suitable for olive cultivation.

A landform was classified to be *unsuitable* for a certain LUT when implementation caused too many problems compared to the yield. This does not imply that a landform was unsuitable during any time in history. During the Bronze Age, clayey areas usually were unsuitable for wheat cultivation, because the soils could not be ploughed easily with a wooden plowshare (4.3). But in subsequent periods, ploughing methods improved and the same areas were now highly praised.

7.1.1 Structure of this chapter

This concluding chapter is divided into the following sections:

The first section (7.2) describes the main aims of this chapter, while in the second part (7.3) the results from the archaeological land evaluation (chapter 3, 4 and 5) are compared with results from related research, such as settlement patterns (Van Leusen 2002), pastoral land use (Veenman 2002) and pollen analysis (chapter 6 of the present volume). In section 7.4, the main aims, which were described in the first chapter, are discussed in the light of the results. Next, section 7.5 explains the overall conclusions of the research in this thesis and finally, some recommendations for future research are given.

¹ The archaeological land evaluation data from the Sibaritide research area could not be tested convincingly with the archaeological data set, because of its limited extension compared to the other two research areas and the limited archaeological data from the research area itself.

7.2 Testing the land evaluation results

In the second chapter of this thesis, the method of archaeological land evaluation was explained. All information needed for this method was given in the third (land qualities of the land systems) and the fourth (ancient agriculture in Central and South Italy) chapter. The results from the archaeological land evaluation were shown in the fifth chapter. In this last chapter, these results will be tested against:

- Archaeological data
 - from surveys, carried out in the research areas. The archaeological results from case studies in the regions (Salento Isthmus and Pontine Region) are compared with the land evaluation results. The case study areas concern the Ostuni area (Salento Isthmus) and the Fogliano and Lepini area (Pontine Region).
 - from the thesis of Veenman (2002), concerning pastoral land use history in Central and South Italy.
- Botanical data
 - from the pollen analysis (chapter 6) from the Agro Pontino cores and previously published results from other cores in Central and South Italy

In the section below, for the research areas and research periods, the land evaluation results are compared with the results from archaeological research in the sample areas described above. First, a summary of the agricultural suitability of the landforms, as was described in chapter 5, is given. Next, various tables show to what extent the archaeological and botanical data confirm the land evaluation results. The differences are explained in the text below each table.

7.2.1 Salento Isthmus

7.2.1.1 Land evaluation results

In the Bronze Age, the Murge land system was unsuitable for all kinds of land use, mainly because of moisture and nutrients deficiencies (figure 5.3 and appendix C-II, table 1). The Brindisi land system could be used for most LUTs, although marginally (mainly because the thin soils were inappropriate for most kinds of arable farming). The exception here could be for the cultivation of emmer wheat and grapes, which need deeper soils to flourish. The suitability of both the Mottola and Palagiano land systems resembled the Brindisi land system. Reasonably, the Taranto land system was avoided, because of the sandy texture of the dunes and the wet conditions of the lagoons (chapter 3).

With regard to Iron Age farming, the Murge area remained unattractive (figure 5.4, appendix C-II, table 2), mainly for the same reasons as described above. The rest of the area could be used for all Iron Age LUTs, although mostly marginally.

The Archaic/Roman Age Salento Isthmus research area turned out to be more suitable than ever before (figure 5.5, appendix C-II, table 3): also in the Murge land system, a few LUTs could be found (cultivation of barley, millet, polyculture of cereals with olives and large-scale olive cultivation).

7.2.1.2 The Ostuni survey

In their article, Attema et al. (forthcoming) present the results from the surveys, which were carried out in the Ostuni region (figure 7.1) in 1999. The main aim was to evaluate the settlement dynamics in the context of the processes of A. centralisation of settlement (circa 1400 to 600 years BC), B. early urbanisation (circa 600 to 250 years BC) and C. Romanisation (from 250 years BC onwards).

Two areas were investigated: one near the cliff-like interface between the Murge and the coastal plain west of Ostuni and one circa 6 km south-west of Ostuni near Cervarolo. In terms of the landform

mapping (chapter 3) the Brindisi (coastal) plain, the Murge concavely sloping land and the Murge rolling land were surveyed. A summary of the results from the surveys is given below.

A. Late Bronze Age and early Iron Age centralisation of settlement

For the middle Bronze Age, low-density sites are found all over the survey areas. A preference can be noted for lower terraces at the interface between hill slopes and valley floors, although people also occupied the concavely sloping land and the lowland plain. Exploitation of the Murge landscape in general was probably rather of an extensive nature, dwellings being fairly mobile. A more permanent and nucleated settlement type could be reconstructed for the late Bronze Age (14th to 11th centuries BC), with sites clustering along the steep ridges looking out over the coastal plain. In Salento in general, most sites of this period were concentrated likewise near to or along the coastline. The same holds good for settlements of the subsequent two centuries, which, however, are poorly attested. Likewise, indications for marine contacts, so evident for the late Bronze Age, are lacking for the 10th/9th century BC. Correspondingly, Burgers (1998) suggests that in this later phase the coastal communities were relatively autarchic. Possibly, the inland areas only were exploited for extensive pastoralism, if at all. Later in the early Iron Age, in the 8th century BC, there is evidence indicating a shift in habitation from the coastal area into inland plains and hills. Thus, in the Murge area new settlements seem to have emerged. Still, most of the Murge is likely to have been exploited only marginally.

B. Early urbanisation and rural infill

During the Archaic period (600 to 325 years BC), most of the Murge still was not used intensively and settlement continued to concentrate in the same areas as in the previous early Iron Age. However, in the early Hellenistic period (325 to 200 years BC), sites appear along a line running just beneath and parallel to the Murge edge. The rather simple farm buildings were preferably built in sloping areas, which could have been used for arboriculture. It is shown that the Murge to some degree participated in the regional trend of agricultural expansion and intensification. Although the survey areas are still small, it can be sustained that even the Cervarolo area on the Murge plateau was part of this trend.

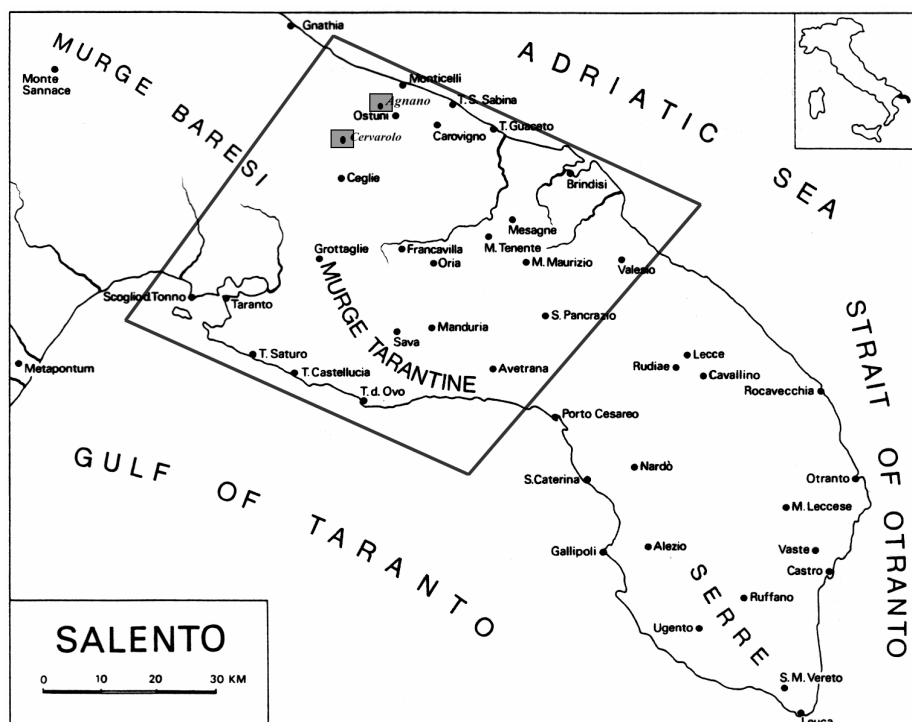


Figure 7.1 Map showing the Ostuni survey area

C. Romanisation

The survey results show no significant changes in number and location of sites until the Roman Imperial period. However, from that period onwards, site patterns are different; there seems to be a tendency towards fewer, but larger estates, in particular in the lowland area around Ostuni. This trend is hypothesised to be related to a scale increase in the agriculture of the area; possibly a process of specialisation in olive cultivation set in this phase.

To conclude, only from the late 4th century BC the landscape of the coastal zone and the Murge plateau was claimed for settlement and agriculture on a substantial scale; Still, subsistence farming seems to have prevailed until at least the Roman Imperial period.

Figure 7.1 shows the location, where the Ostuni (in 1999) survey took place.

7.2.1.3 The pastoral history in the Salento Isthmus

For the period from the late Bronze Age until the late Iron Age, Veenman (2002, 130–132) reconstructed three pastoral strategies for Salento on the basis of zoological (bone) material: a self-subsistence, mixed farming strategy and two short-distance transhumance strategies with permanent settlements.

Successively, from the Hellenistic period onwards (starting from the late 4th century BC), the symbiotic relationship between agriculture and animal husbandry ceased, while a single product specialisation emerged, such as pig and sheep rearing or olive cultivation.

7.2.1.4 Discussion

The results from the archaeological survey in the Murge land system are confirmed by the land evaluation results (unsuitable area versus a marginal anthropogenic use), except for the Archaic/Roman Age. Although the land system was classified marginally suitable and unsuitable for farming activities, the surveys suggest a rather intensive use of the areas with accompanying subsistence farming. This controversy can partly be explained by difference of scale. Surveys took place at agricultural field level, in which every geomorphological feature (valley, top, relatively level areas) was examined and mapped. However, although the land systems were divided into landforms and sub-landforms, still the mapping scale did not coincide with the survey scale. Therefore, for this region, I recommend small-scale landscape mapping. Probably, this will come up with selected areas that were relatively well suited for specific farming activities, such as subsistence farming.

But the controversy can also be explained by the fact that some landforms could be used for agriculture requiring additional effort, such as manuring. Probably, reasons such as safety or ample locations for grazing (Veenman 2002) could have influenced the settlement location.

Because of its large extent, the landforms in the Brindisi land system were classified to be unsuitable, marginally suitable and suitable. This is the main reason for the positive test results. More small-scale suitability maps are necessary for archaeological detailed questions.

Land system	Murge						Brindisi		
Landform	Rolling land			Concavely sloping land			Plain		
	arch	ler	test	arch	ler	test	arch	ler	test
Bronze Age	marginally used	3	+	marginally used	3	+	intensively used	1,2,3	+
Iron Age	marginally used	3	+	relative intensive use	3	-	marginally used	1,2,3	+
Archaic/Roman Age	relative intensive use	2,3	-	relative intensive use	2,3	-	relative intensive use	1,2,3	+

Table 7.0 Test based on archaeological evidence: arch = archaeological results; ler = land evaluation results; 1 = suitable; 2 = marginally suitable; 3 = unsuitable for agriculture; + = archaeological data confirm land evaluation results; - = archaeological data deviate from the land evaluation results

7.2.2 Agro Pontino

7.2.2.1 Summary of the archaeological land evaluation results in the Agro Pontino

As in Bronze Age Salento, self-subsistence farming was classified to be the most profitable (in terms of minimum effort) LUT in the Agro Pontino during the Bronze Age (5.5.2.1 and appendix C-II). The beach ridges, the aeolian area and the alluvial fans of the Lepini mountains were suitable or marginally suitable for autarkic agriculture (figure 5.6 d). Emmer wheat (figure 5.6 a) could be marginally cultivated only on the alluvial fans, while other wheat species (figure 5.6 b) could be grown in the aeolian area too. The moderately steep to steep Monti Lepini land system remained unsuitable for any kind of Bronze Age agriculture, mainly because of workability problems, but also because of moisture and/or nutrient availability (thin soils). The former Pontine Marshes still were too wet to be cultivated. These were drained only recently during the 1930s (1.4.3.1). Finally, the Amaseno lagoonal/alluvial area (3.4.4.3) in the eastern part of the research area also was too wet for any kind of farming.

Although during the Iron Age most landforms remained unsuitable for agriculture, changes occurred in the natural environment that had an effect on land use conditions. The Amaseno region for instance changed from a wet marshy area into increasingly dry land due to fluvio-colluvial deposition and as a result became marginally suitable for all land Iron Age use types: simultaneous cultivation of cereals with olives or grapes, permanent cultivation and self-subsistence farming (figure 5.7). A comparable change was noted in the plain below the Roman colony of Setia. The suitability of the aeolian area resembled the Bronze Age: it was marginally suitable for the polycultural system of cereals with olives or grapes (figure 5.7a and b) and suitable for autarkic farming and permanent cultivation of favoured plots (5.7 c and d).

Technological developments in agriculture increased the suitability of the Pontine region for Roman Age LUTs: cereals, such as barley, millet and wheat could be grown, although marginally, on most dry landforms in the plain. The south lying horst could be used to some extent for the cultivation of cereals with olives and grapes. Finally, from the Roman Age, the Amaseno alluvial fans were suitable for cereal with grape cultivation and autarkic farming. Recent archaeological studies have shown that between the end of the 4th and 2nd centuries BC, Roman agriculture expanded along the Lepine and Ausoni foothills. Villae rusticae built on platforms raised in polygonal masonry now appear at regular distances along the *pedemontana*, the foot of the mountains (de Haas forthcoming). These medium-sized villae, that may have used slave labour, were the first to invest and specialize in specific crops, in this case most probably the growing of olive trees. It is in this period that the socio-economic system shifts from subsistence farming to cash cropping and from family based farming to input of slave labour. In the near future the archaeological data for the Pontine region will be of such quality that the land evaluation models elaborated in this thesis can be tested region-wide against the archaeological data (personal communication professor Attema). Here I will limit myself to two survey areas with which I am acquainted through my own fieldwork. These concern the area around Lago di Fogliano on the Tyrrhenian coast and the area around Doganella di Ninfa in the foothill zone of the Monti Lepini. Both areas were intensively surveyed within the framework of the RPC-project (Attema et al. 2002a, Van Leusen 2002)

7.2.2.2 Land evaluation and archaeology in the Pontine region: the Fogliano and Lepini surveys

Figure 7.2 shows the location of the Lago di Fogliano and the Doganella di Ninfa survey areas, while the corresponding land systems can be found in figure 3.16 of the previous chapter.

Summary of the results from the Fogliano survey

Attema et al. (2002a) describe the results from a combined archaeological and physiographical research in the Lago di Fogliano area. Lithic material collected during the Fogliano survey proved human presence in the survey area at least from the Palaeolithic period pointing at an intensive and con-

tinuous use of this area by hunter-gatherer groups (cf also Voorrips et al. 1991) into the Neolithic. Archaeological data indicate that permanent settlement started in the Bronze Age (Alessandri 2000–2001 for an overview). According to the archaeologists, the beach ridge complex was however until the Archaic Age only marginally used with small and few settlements scattered over the landscape (Attema et al. 2002a). It must be noted that no early urban settlements are known in the immediate vicinity of lake Fogliano, the nearest being located in the Astura river valley (Satricum, figure 1.5). It is thought that in protohistory the area knew a marginal economy. The lagoon and nearby marshy areas were probably used for, for instance, fishing, hunting, grazing of animals and collecting of wood, while it is thought that self-subsistence farming was the main land use type on the beach ridges and the aeolian area. To which use the recent dunes were put is unknown, although recent research carried out as part of the more recent Astura project of the Groningen Institute of Archaeology, has revealed the existence of late Bronze age and Iron age sites along the coast. These specialized in marine resources (probably salt) featuring a supporting pottery production (Attema, Nijboer and Rooke 2002, Attema et al. forthcoming, see also Alessandri 2000–2001). In the economic system of the early protohistorical period such sites must have been dependent on the larger settlements located more inland (Angle et al. 1992). In the Fogliano survey, special activity sites along the coast were, however, not detected and neither is there any archaeological evidence known pointing at farming activities in the recent dunes (personal communication professor Attema).

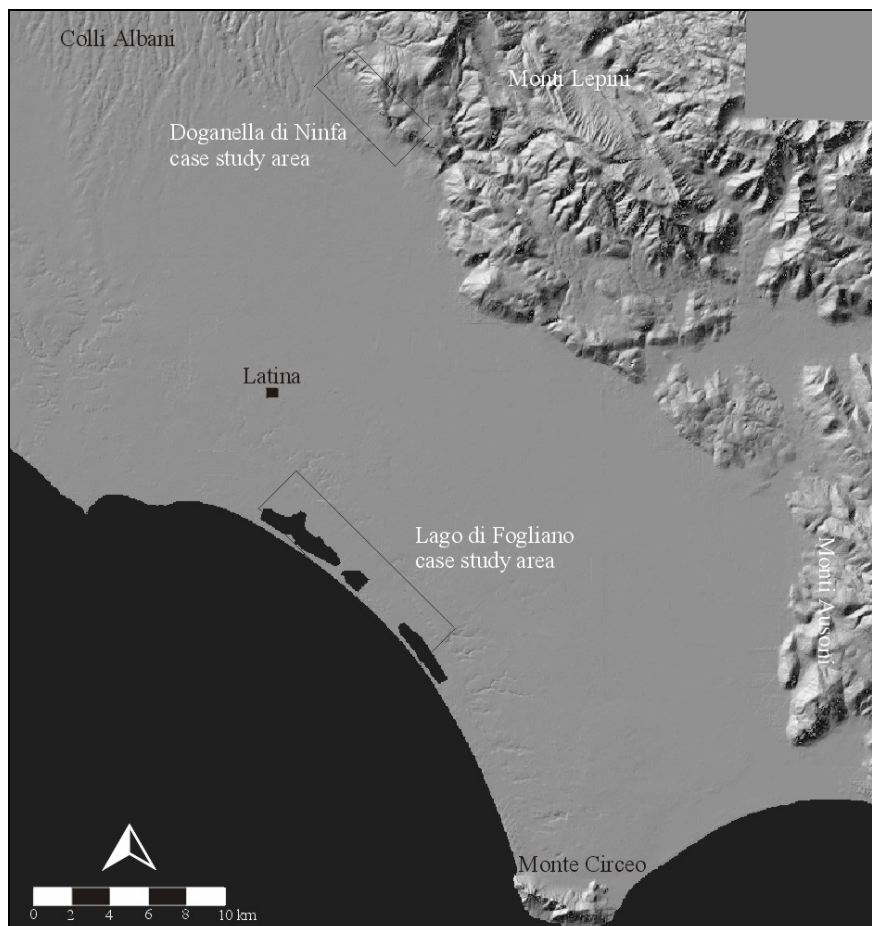


Figure 7.2 Map showing location of the Fogliano and Doganella di Ninfa survey areas in the Agro Pontino

From the post-Archaic period onwards, the settlement intensity slightly increased in the Fogliano area, especially in the aeolian part indicating a growing interest in the agricultural potential of the area that is also attested elsewhere in the Pontine plain, notably in the Agro Pontino survey (Voorrips et al. 1991). But compared to the Lepine margins, where agricultural colonization by the Romans started

already in the mid fourth century BC, the beach ridge complex was colonized rather late by the Romans, and it is only in the late Republican period that the villa system makes its appearance. Now probably relatively large fertile areas were preferred for large-scale farming activities, such as olive and grape cultivation. This is also the period in which the so-called villae maritimae were built on the coast often equipped with large fish basins (piscinae). Such villae belonged to the Roman elite.

Discussion

In table 7.1, the results from the archaeological land evaluation are compared with the results of the Fogliano survey. As indicated above, the Fogliano land system has not yielded any archaeological evidence that points to farming, but during all periods, there is reason to believe that the lagoons were used for fishing (Attema et al. 2002a). The beach ridge system (UL) proved to be (marginally) suitable for autarkic agriculture in probability and later on also for Roman Age land use types, and the settlement data confirm this, although the pottery from the proto-historical period could not be dated very accurately due to the absence of diagnostics forms (pers. Comm. Attema). The unfertile plain (level lagoonal unit) showed no archaeological signs of any use (zero pre-Roman find density per ha; figures 4 and 5, Van Leusen 2002, chapter 10). The floodplain area in the Borgo Grappa land system is omitted from this test, because no land evaluation data are available (3.4.6 B). It can be concluded that the results from the archaeological land evaluation are largely confirmed by the archaeological results from the Fogliano case-study area.

Land system	Fogliano						Borgo Grappa					
Landform	Dune			Lagoon			Undulating land			Plain		
	arch	ler	test	Arch	ler	test	arch	ler	test	arch	ler	test
Bronze Age	Pot?	3	+	Lit	Nlda	X	Marg used	1,2	+	Nada	3	+
Iron Age	Pot?	3	+	Lit	Nlda	X	Marg used	1,2	+	Nada	3	+
Archaic/Roman Age	?	3	+	Lit	Nlda	X	Intensively used	1,2	+	Nada	3	+

Table 7.1 Test based on archaeological evidence: arch = archaeological results; ler = land evaluation results; Pot = pottery sherds; 1 = suitable; 2 = marginally suitable; 3 = unsuitable for agriculture; Lit = evidence from the literature; nlda = no land evaluation data available; nada = no archaeological data available; X = test is impossible; + = archaeological data confirm land evaluation results

Surveys in the Monti Lepini

Systematic surveys in the foothills of the Monti Lepini were first carried out by Attema (1993) following the topographical studies by Brandizzi Vittucci in the catchment of Cora (Vittucci 1968). While Vittucci's surveys were mainly focused on the Roman landscape, Attema's systematic surveys were focused on the protohistorical landscape. Over the years the protourban settlement of Valvisciolo/Caracupa, located on the steep slopes of the hilltop of the Monte Carbolino and the alluvial fan below it as well as the nearby Iron age and Archaic hilltop of Contrada Casali and the rural landscape between Valvisciolo/Caracupa and the Roman colony of Setia were surveyed. In 1995, Attema, Bailey and King did further work on the slopes below Norba in a campaign that was specifically dedicated to the mapping of Roman platform villae (Van Leusen 2002). Attema and van Leusen added to this an intensive survey between the latter zone and the Roman colony of Cora, which they labeled the Doganella di Ninfa survey (Van Leusen 2002, chapter 9). This survey was designed to evaluate continuity and discontinuity in the use of the rural landscape between the Iron Age and the Roman period. The results indeed pointed to a large measure of continuity, although the nature of the archaeological evidence is very different from that of the Roman period (Van Leusen 2002, chapter 9). While the Roman villae often have imposing terrace walls in polygonal blocks preserved, the Iron Age to post-Archaic rural buildings are only recognizable through the careful mapping of surface artefact scatters. Recently a team led by de Haas revisited a number of these Roman platforms in the area aiming at providing a closer dating of these conspicuous remains. His study of diagnostic potsherds that were picked up from the villa terrains point to a construction date not before the end of the 4th c. BC, and rather in the 3rd century BC, while almost all terrains demonstrated a continuous use from the Iron Age

into the Imperial period, thereby corroborating the results from earlier studies (de Haas 2003). According to de Haas, the change from Iron age/Archaic to Roman rural exploitation reflects a new socio-economic order characterized by modest labour investment (slaves) and specialization (olives, wine grapes).

On the basis of the data available the general settlement trend in the foothills of the Monti Lepini may be delineated as follows. For the early Iron Age (around 800 BC), there is evidence for a proto-urban settlement at Caracupa/Valvisciolo, while several other hilltops may have been settled as well. Rural infill, especially related with the growth of Caracupa/Valvisciolo, takes place in the 7th and 6th c. BC. This took place on a considerable scale as the above mentioned recent surveys have shown. There is no indication for a setback in the 5th and 4th c. BC, when the Pontine region is the scene of warfare between Romans, Latins and mountain tribes. This is the period in which, according to the sources, the Romans founded the colony of Norba (Attema 2000). As a result of Roman colonization policy, three settlements in the Lepine foothills developed that grew into central places with urban characteristics. These are Cora, Norba and Setia. In their catchments Roman villae were founded from around 300 BC that would exploit the rural landscape intensively, probably producing specific products (olive oil, wine) for a local market. From this overview it follows that from an early period (at least from in around 700 BC) the Lepine foothills was an area where subsistence farming took place and where in Roman times farming specialised in cash crops. In the following, we will see how this matches with the land evaluation, for which I will foremost use the settlement data from the Doganella di Ninfa survey, as described by Van Leusen in *“the Archaic settlement and early Roman colonization of the Lepine foothills”* (chapter 9 in Van Leusen 2002).

The Doganella di Ninfa surveys were predominantly executed on the slope deposits of the Monti Lepini (described by Sevink et al. 1984 and in chapter 3 of this volume). Iron Age as well as Archaic sherds were found both on Roman villa terrains and outside these terrains, and most sites were found at elevations ranging between 60 and 150 m above sea level. This led Attema and van Leusen to suggest that settlement in the Roman period took place on a lesser number of larger farm sites in the Roman period (Van Leusen 2002). Fig. 7.2 shows the survey area of the Doganella di Ninfa survey

Discussion

In table 7.2, the results from the archaeological land evaluation and the archaeological results of the survey are compared. No archaeological data from the Lepine river valleys is available yet and the test is therefore limited to the undulating gently sloping landform and the slopes of the Monti Lepini. In the survey, in neither of these landforms Bronze Age sherds were found, and this would tally with the results of the land evaluation that mark the area as unsuitable for any kind of agriculture because of stoniness and the slope gradient of the Lepini mountains. But we have to be careful here, since adverse conditions for archaeological surface survey may easily have obscured finds from this period, but we can be certain that settlement was thin. According to the land evaluation results (chapter 5, appendix C-II) the agricultural suitability of the slope deposits only slightly increased in the periods of the Iron Age and Roman Age, whereas the Lepini mountains themselves remained unsuitable. The latter is confirmed by the absence of archaeological data. But the many sites dating between the Iron age and the Roman period that were found on the slope deposits during the Doganella di Ninfa survey deviate from the land evaluation results, as the slope deposits were marked as unsuitable or marginally suitable for agriculture, that is except for self-subsistence farming. It is the latter use that we may link to the Iron Age to post-Archaic occupation, although it probably took place on a larger scale than expected from the land evaluation. Apparently for reasons other than the cultivation of food, such as safety, people decided to settle at these locations, taking the additional effort to grow crops for granted.

In the Roman period it is highly probable that specialisation took place with farmers investing in the growing of olive trees. That this happened on a substantial scale is clear from the many Roman platform villae that were founded on the lower slopes, the finds of olive press beds and pollen data as we will see below (and which were shown in the previous chapter). Also today, land use on the lower slopes is dominated by olive groves. This is confirmed by the results from the archaeological land evaluation (appendix C-II, table 6), which shows that all landforms in the Monti Lepini land system

were marginally suitable for specialised olive cultivation, in that nutrients availability and erosion hazard were the main constraints.

Land system	Monti Lepini								
Landform	Undulating gently sloping land			Mountain			River valley		
	arch	ler	test	arch	ler	test	Arch	ler	test
Bronze Age	Nada	1,3	X	Nada	3	X	Nada	1,3	X
Iron Age	Sherds	1,2,3	-	Nada	3	X	Nada	1,2,3	X
Archaic/ Roman Age	Sherds	1,2,3	-	Nada	3	X	Nada	1,2,3	X

Table 7.2 Test based on archaeological evidence: arch = archaeological results; ler = land evaluation results; 1 = suitable; 2 = marginally suitable; 3 = unsuitable for agriculture; nada = no archaeological data available; X = test is impossible; - = archaeological data deviate from the land evaluation data

7.2.2.3 Land evaluation and pollen data

Apart from testing the land evaluation results of the Agro Pontino by means of the archaeological data, we can, in the case of the Agro Pontino, also test the model by means of the pollen data from the analyses of several cores taken in the different land systems. These clearly show a continuous human impact from the Bronze Age onwards in all land systems. We will summarize the main results as could be read in the diagrams (cf. chapter 6) for respectively the Bronze Age, the Iron Age/Archaic period, and the Roman period.

As far as the Bronze Age is concerned the diagrams are indicative of:

- Bronze Age agricultural and pastoral activities in the vicinity of Mezzaluna (Hunt and Eisner 1991) and probably on the Lepini foothills,
- Bronze Age cereal cultivation on the volcanic slopes of the Alban hills (Lowe et al. 1996, Veenman 1996),
- Bronze Age small-scale wheat cultivation in the vicinity of Lago di Fogliano, probably on the aeolian deposits east of the lagoon or on the beach ridges.

Furthermore the pollen diagrams indicate that a rather deep mesotrophic to eutrophic lagoon existed in the Fogliano survey area and gave evidence for the existence of (a) rather deep lake(s) at the location of the pollen core of Vescovo, an area that changed to a marshy environment during the later research periods.

For the Iron Age the diagrams show:

- Iron Age cereal cultivation (barley and wheat/rye) in the volcanic area (Lowe et al. 1996, see also the Colle San Lorenzo core),
- Iron Age farming activities (proved by secondary agricultural indicators) in the Lago di Fogliano area,

while for the Roman period there is evidence for:

- cereal cultivation and a large expansion of chestnut, walnut and olive on the volcanic slopes of the Alban hills (Lowe et al. 1996 and the Colle San Lorenzo-core),
- cereal cultivation in the Lago di Fogliano area,
- cultivation of olive, walnut and chestnut near Monticchio on the Monti Lepini (Haagsma 1993),
- cultivation of olives and sweet chestnut on the foothills of the Monti Lepini (see the Vescovo-core).

Discussion

Table 7.3 shows the archaeological land evaluation results compared with the Pontine palynological data. As stated, the Fogliano dunes and the lagoon itself were in the land evaluation model marked as unsuitable for any kind of agriculture in any research period, because of their unfertile characteristics.

In the Bronze Age, the beach ridges (UL) of the Borgo Grappa land system were suitable for self-subsistence farming only, which is confirmed by the botanical results. However, in the Iron Age, suitability slightly improved for cultivation of olives with cereals, whereas self-subsistence farming remained possible. The pollen diagram does not show any sign of these kinds of land use. The Roman age land evaluation results are largely confirmed by the botanical data. The area was (marginally) suitable for many kinds of agriculture. However, more pollen from, for example, olives would have been expected, because the area is classified to be suitable for specialised olive cultivation (appendix C-II: table 6).

The suitability of the fertile aeolian area is not confirmed by the palynological data. This can partly be explained by the fact that cereal pollen can be found only in the vicinity of the parent vegetation and, for instance, grape cultivation is difficult to prove from pollen analysis (self-pollination; chapter 6). Because of this nature of pollen distribution, the occurring vegetation cannot always be found in the pollen cores.

Land system	Fogliano				Borgo Grappa					
Landform	Dune		Lagoon		Undulating land			Plain		
Sub landform					Beach ridge			Aeolian		
	botan	test	botan	test	botan	ler	test	Botan	ler	test
Bronze Age	npda	X	npda	X	wheat	1,3	+	no agricultural indicators	1,2,3	-
Iron Age	npda	X	npda	X	second	1,2,3	-	Secondary indicators	1,2	-
Archaic/ Roman Age	npda	X	npda	X	cereals	1,2,3	+	no agricultural indicators	1,2,3	-

Land system	Monti Lepini						
Landform	Undulating gently sloping land			Mountains		River valley	
	botan	ler	test	botan	test	Botan	test
Bronze Age	secondary indicators	1,3	+	npda	X	Npda	X
Iron Age	npda	1,2,3	X	npda	X	Npda	X
Archaic/ Roman Age	olive, walnut and chestnut	1,2,3	+	npda	X	Npda	X

Land system	Latina						
Landform	Plain						
Sub landform	Amaseno alluvial fan			Sezze alluvial fan			
	botan	ler	test	botan	ler	test	
Bronze Age	?	3	X	npda	2	X	
Iron Age	npda	3	X	npda	2,3	X	
Archaic/ Roman Age	olive, chestnut	1,2,3	+	olive, walnut, chestnut	1,2,3	+	

Table 7.3 Test based on palynological evidence: botan = botanical data; ler = land evaluation results; npda = no palynological data available; 1 = suitable; 2 = marginally suitable; 3 = unsuitable; X = test is impossible; + = palynological data confirm land evaluation results, - = palynological data deviate from the land evaluation results

7.2.2.4 The pastoral history in the Pontine region

Only from the Iron Age onwards, the Amaseno area of the Latina land system could be used for agriculture. But the Vescovo-core does not show significant rises of agricultural indicators. The Bronze Age agricultural signal in the Mezzaluna-core may be a reflection of farming activities on the Sezze alluvial fan, but this can be no more than an assumption. For the Iron Age, no pollen data are available, whereas the Monticchio-core (Haagma 1993) shows Roman Age olive cultivation. According to the land evaluation results, the Sezze alluvial fan area was marginally suitable for specialised olive

cultivation. An investment in this kind of farming was indeed made by Roman farmers as archaeology has shown.

In the Bronze Age, the undulating gently sloping land of the Lepini mountains was suitable for self-subsistence farming, which can be deduced from the results from the Mezzaluna core (Hunt and Eisner 1991). Both the Monticchio-core and the Vescovo-core show increasing agricultural activities on the foothills of the Monti Lepini during the Roman Age. This is confirmed by the increasing suitability of the area (appendix C-II: table 6). The steep slopes of the mountains remained unsuitable for any kind of agriculture.

Former Pontine Marshes

Although the Pontine Marshes showed no opportunities for arable farming during the research periods (from the Bronze Age until the Roman Age), Veenman (2002) argues that they could have been used for various other means of subsistence. In her thesis, Veenman (2002, 119–122) investigated the 19th century BC occupation of the marshy Pontine plain. She concludes that hunters, fishermen, farmers and herdsmen, who temporarily lived in the so-called *lestre* (dry islands in the wet marshes, on which huts, winter meadows and farming land were situated), inhabited the area. Although Veenman warns that the *lestre* strategy cannot be projected on the first millennium BC societies, she emphasized that, despite the fact that the area was limited for arable farming, the marshy area was all but marginal: in antiquity it could have been used for self-subsistence farming (Attema 1993), fishing, hunting and for the gathering of timber as well.

Another interesting aspect of Veenmans thesis (2002) concerned transhumance strategies in the Pontine region: before the 4th century BC, short-distance transhumance² was common practice, while the desirable conditions for long-distance transhumance emerged after the 4th century BC. Probably, the higher parts of the Pontine plain (especially south of Lago di Fogliano) were used as winter meadows, while during summer, the flock of sheep and/or goats retreated into the mountainous areas.

7.2.4.5 Conclusions

Some final remarks: the Amaseno alluvial area

Although the Amaseno area landscape reconstruction and the land evaluation revealed that the area improved from a marshy lagoon into a marginal and, later on, even suitable area for agriculture, no archaeological evidence of human occupation is currently available. During the Agro Pontino Survey Project (Voorrips et al. 1991), only some five fields were surveyed³, while the area was not taken in consideration during the RPC fieldwork campaigns. Some research on the Roman period has been carried out in the vicinity of Terracina, where Roman Age centuriation phenomena and a large number of Roman villae were mapped (cf. Lugli 1926). But it still remains uncertain if, when and to what extent occupation took place on the footslopes of the Monti Ausoni in earlier periods, and whether agriculture was practiced on the alluvial sediments. Thereby, results from pollen analysis are missing, mainly because of the sediment type.

In conclusion, I take the opportunity of recommending additional archaeological, botanical and more detailed pedological research in this area, which seems to have been a favourable area for habitation from the Iron Age onwards: (rather) suitable farming land and ample locations for (safe) occupation.

² Veenman (2002, 116) defines *short-distance* transhumance as a system of herdsmen travelling with their cattle distances of less than 125 km between the meadows and *long-distance* transhumance as a system of herdsmen travelling several hundreds of km between the summer and winter meadows.

³ Some results from the survey in the Amaseno area: three findspots of Archaic pottery and three with Roman pottery

7.3 Conclusions

This section describes the main conclusions, which can be drawn from the overall research in this thesis. The many sub-conclusions, which were made in the previous chapters, are omitted here.

7.3.1 Have the aims been achieved?

The overall aim of this thesis was to analyse the long-term relations between people and their natural environment by means of an archaeological land evaluation of the RPC study areas. With the results from this research the model of traditional Mediterranean agriculture can be adjusted or corrected. The method of archaeological land evaluation itself has been changed and adapted for archaeological use.

The main goals for this research were:

- To optimize the land evaluation method for archaeological purposes,
- To determine the suitability of various landscapes for various land uses in three periods (Bronze Age, Iron Age and Archaic/Roman Age),
- To reconstruct the vegetation history of the Pontine Region (Central Italy),
- To test the land evaluation results with archaeological and palynological results,
- To adjust the generally accepted model of traditional Mediterranean agriculture.
- To compare the archaeological land evaluation data for the three research areas: Agro Pontino, Salento Isthmus and Sibaritide

7.3.2 Research method: ways and means

In order to achieve the above-described aims, two main research methods were used: archaeological land evaluation and pollen analysis. Below, a summary of the research methods, including accompanying research techniques, is given.

Potential land evaluation in Archaeology

In chapter 2, the archaeological land evaluation method was explained. In order to carry out a land evaluation, several individual steps had to be made, which fulfill the first two aims. These steps were:

- A physiographical reconstruction of the research areas, (re-)mapping of the research areas in land systems and landforms and a detailed description of the constituting elements (land characteristics), such as slope percentage, stoniness and soil type. In chapter 3, the research results were presented. This thesis provides the first map of land systems and landforms of the Salento Isthmus.
- A reconstruction of the first millennium land utilization types (LUTs), including agricultural tools and technology, crops and farming systems and the accompanying soil and management requirements of these LUTs. According to Forni (1989), the last two millennia before the birth of Christ can be divided into four agricultural phases. Each phase, with its characteristic LUTs, was described in detail in the fourth chapter. Also, the results from the research into the land use requirements of emmer wheat were shown.
- The next step, the determination and classification of the suitability of the (reconstructed) land systems for the Bronze Age, Iron Age and Archaic/Roman Age land utilization types was found in chapter 5. A special computerized land evaluation program, ALES, was used to determine these suitability classes. Although the land evaluation program was used before in Archaeology (Farshad 1997), the program was first introduced by the author into the Groningen University and can be consulted anytime for future research.

The mapping of the areas in land systems and landforms turned out to be a convenient method, especially when an area has not been mapped before. In terms of land evaluation, the units can be easily classified.

7.3.3 Pollen analysis

The third aim was achieved by pollen analysis. In the Agro Pontino, three cores were taken: Lago di Fogliano, Colle San Lorenzo and Laghi di Vescovo. Special attention was paid to probable agricultural phases and/or other signs of anthropogenic interference with the landscape. The results were described in the sixth chapter and were used as independent information to test the results from the land evaluation.

In testing the archaeological land evaluation results with palynological data, some problems were met. The origin of regional or even extra-regional pollen is uncertain, while the land evaluation data were derived at location level. Only large-scale changes in the regional vegetation could be reconstructed (for example on land system scale). An exception from cereal pollen and certain herbaceous pollen, whose species indicate local agricultural activities. Another problem concerns the fact that if for a certain area pollen data lack, this does not mean that the area is agriculturally unsuitable.

The combined testing of the land evaluation results with palynological and archaeological data proves to be the best solution. Local agricultural activities are evidently shown in pollen diagrams, while data concerning settlement patterns are shown in the survey data.

7.3.4 Adjustment of the traditional Mediterranean agricultural model

The traditional Central Italian agricultural model (including pastoralism) can be summarised as a Bronze Age system of subsistence farming associated with hunting and fishing activities, while the Iron Age system can be characterised as a relatively primitive system of mixed farming (cultivation of cereals and legumes together with the breeding of sheep and goats) on a larger scale than before. In the Archaic/Roman Age, a change to polycultural systems emerged. Transhumance (whether at large-scale or local) maintained importance into the Roman Age. However, after 200 BC, the peasant economy was gradually replaced by “capitalistic” *latifundiae*: large farms, which were specialised in stock-raising or cultivation of olives and grapes.

The traditional Southern Italian agricultural model can be summarised as a Bronze Age system of extensive pastoralism, subsistence farming and hunting and an Iron Age more extended system of subsistence farming and animal husbandry, probably associated with small-scale hunting activities. Agriculture was more and more focused on surplus production (for example cereals) during the later periods (Archaic and Roman Age), together with an intensification of wine and olive oil production (*Roman villae* or *latifundiae*).

In the fourth chapter, ancient agricultural systems were described according to Forni 1989, 1990 and 2002), including an overview of ancient ploughs or parts of ploughs found in Italy. This chapter adds valuable data to the traditional agricultural model, especially concerning farming techniques and tools and concerning cultivated crops. It was shown that even from the Bronze Age, ploughs with convertible wooden ploughshares were used (although they were probably not common). Cereals and leguminosae were grown (in the Agro Pontino it was proved that agricultural activities occurred from at least the Neolithic period), while the first evidence for olive cultivation and domestic vine was found in Southern Italy. Although iron tools were invented in the Iron Age, the metal was fully used in agriculture only from the Roman Age onwards. This contrasts with the traditional model, which describes the use of Iron from the Iron Age. Also, the wheeled plough was used only in Northern Italy, which commonly contrasts with the general opinion. The chapter adds a detailed look into the soil and management requirements of ancient crops, especially concerning emmer wheat (*Triticum dicoccum*), which deviate from modern crops.

The test results in this chapter show that occasionally ancient people choose to live in marginally suitable areas, even though it meant a (heavy) investment in agriculture. Apparently, factors as safety influenced settlement choice. This may seem to be an open door theory, but in this thesis it was proved in combination with archaeological results.

7.3.5 Comparisons of archaeological land evaluation data sets for the three research areas: Agro Pontino, Salento Isthmus and Sibaritide

In order to carry out the archaeological land evaluation in three separate areas with the aim to compare the results in the end, the basic premises have to correspond with each other. Although the Sibaritide research area is much smaller than both the Agro Pontino and Salento Isthmus research areas, all areas were mapped in the same way. That is the areas were mapped into land systems, landforms and sub-landforms (chapter 2). But, next to the divergent size of the areas, more differences were encountered:

- The soil map of the Agro Pontino (Sevink et al. 1984) includes a lot of information, which is not yet available for the research areas in Southern Italy. During the fieldwork necessary for this thesis, the first large-scale geomorphological map of the Salento was made. The landscape reconstruction for the Agro Pontino turned out to be more detailed. Therefore, the land evaluation results also were more detailed, in that the Pontine landforms were classified suitable, marginally suitable or unsuitable, while the landforms in the Salento Isthmus were classified less clear: partly suitable, partly unsuitable or partly marginally suitable, partly suitable, due to the large extent of the area.
- The environmental conditions in the Agro Pontino prove to be better suited for pollen conservation than those in the Southern Italian areas, which generally are too dry. This explains why for Central Italy many pollen diagrams are available, which could be used to test the archaeological land evaluation results. Unfortunately, this test was impossible for the Salento and Sibaritide research areas.
- For the Pontine Region and Salento Isthmus, more detailed archaeological information is available than for the Sibaritide, where surveys only just started (Attema et al. in press, Van Leusen and Attema forthcoming).

7.4 Recommendations for future research

More detailed research into landscape reconstruction for the two research areas Salento Isthmus and Sibaritide in Southern Italy is necessary. Due to the large extent of the research areas and the fact that the Salento Isthmus was never geomorphologically mapped before, a detailed reconstruction of past environmental processes was carried out insufficiently. Besides, for comparing the archaeological data at field level with the land evaluation results, more detailed mapping of the land systems is necessary in the Salento and the Sibaritide.

Iso, more biotic research (pollen analysis, macro-remains) in South Italy is necessary in gaining more insight into the dynamics of the landscape and particularly, into anthropogenic influence (for example deforestation and agriculture).

7.5 Summary

As mentioned in the preface, the aim of this thesis is to provide an overview of the potential land use suitability of three Central- and South Italian (Agro Pontino, Salento Isthmus and Sibaritide) landscapes in the past (from the Bronze Age until the Roman period). This suitability can be an explana-

tion for settlement location (also in the past). The method used for the determination of the suitability of land for special types of agriculture is called 'land evaluation' in this thesis. The method 'land evaluation' is not new (FAO 1976), but in this research it is further adjusted and focused on archaeological questions.

The method is based on two pillars: the *land qualities* (physical, geomorphological and chemical characteristics of a part of a landscape) and the *land utilisation types* (LUT's: agricultural technologies and/or crops known and used in special areas and periods). By comparing the requirements of the land use types with the characteristics of the ground, a suitability classification can be made.

The present soil qualities in the three research areas deviate from those in the past, because of, for example, natural and/or anthropogenic erosional and depositional processes. Due to this, landscape reconstructions were carried out first, from which more (Agro Pontino) or less (the other two areas) was shown what these areas appeared to be in the past, and how they could be used for agricultural purposes. Many geomorphological investigations in the research areas gave a lot of valuable information. In the land evaluation procedure, each research area is divided in three smaller parts, so-called *land systems*, representing an area or areas with common landforms (such as hills or river valleys), soils and vegetation (CSIRO 1963). Each land system (such as a dune-landscape) was examined according to a fixed set of possible qualities, for example, texture, soil type and stoniness in the upper part of the soil. These results are shown in chapter three of this thesis.

Chapter four describes the land use types in Central-and South Italy, as reconstructed by Forni (1990) for the three research periods (Bronze Age, Iron Age and Archaic/Roman period). Forni used ancient ploughs or parts of ploughs (discoveries (the oldest plough found in Italy dates to 2000 BC)), fossil plough furrows and land use types portrayed on ancient pottery or walls in caves, to make these reconstructions. To carry out a thorough investigation, he did not only use literary data from the ancient sources.

Comparing all data, for the one hand derived from the landscape-research (all landscape-characteristics) and for the other from the archaeological/historical research (all agrarian/technological data), was made easier by using the computer-program ALES. After entering the above-mentioned data the suitability of a special landform for a special land use-type can be determined.

Land suitability maps show the suitability of each landform for a certain land use type during a certain archaeological period. These maps are tested against modern land use maps (section 5.6) and pollen analytical data (chapter 6). By carrying out pollen analysis from material from three peaty locations in the Agro Pontino, various land use types (such as cereal and olive cultivation) and anthropogenic environmental influence (deforestation) was proved. In the last chapter of this thesis, these palynological data were tested against the land evaluation data.

7.6 Samenvatting

Zoals in het voorwoord reeds was aangegeven, vormt het doel van dit proefschrift een indruk te geven van de potentiële geschiktheid van drie Midden- en Zuid-Italiaanse landschappen (Agro Pontino, Salento Isthmus en Sibaritide) voor specifieke landgebruikstypen in de oudheid (vanaf de Bronstijd tot en met de Romeinse Tijd). Deze geschiktheid kan een verklaring vormen voor de vestigingskeuze van mensen op een bepaalde locatie (in het verleden). De methode die gebruikt is voor het bepalen van de geschiktheid van gronden voor bepaalde typen van landbouw wordt in dit proefschrift archeologische landevaluatie genoemd. Hoewel de methode niet nieuw is (FAO 1976), is deze in dit onderzoek verder uitgediept en toegespitst op archeologische vraagstukken.

De methode rust op twee pijlers: de *land qualities* (het geheel van fysische, geomorfologische en chemische karakteristieken van een landschapselement) en de *land utilisation types* (LUTs: het geheel van agrarische technologieën en/of gewassen, dat bekend was en toegepast werd in een bepaald gebied in een bepaalde periode). Door de eisen die de landgebruikstypen stelden aan de grond en/of het landschap te vergelijken met de karakteristieken van die grond en/of dat landschap, wordt een geschikt-

heidsklassificering mogelijk.

De huidige kwaliteiten van de gronden in de drie onderzoeksgebieden zijn niet geheel dezelfde als in het verleden, als gevolg van bijvoorbeeld natuurlijke en/of antropogene erosieve en depositionele processen. Daarom werden eerst reconstructies van de landschappen uitgevoerd, waaruit in meer (Agro Pontino) of mindere mate (de andere twee onderzoeksgebieden) duidelijk wordt hoe deze gebieden er in het verleden uitgezien hebben en hoe deze gebruikt werden voor landbouw. Talloze onderzoeken in de onderzoeksgebieden hebben een schat aan informatie opgeleverd. Voor de landevaluatie is elk onderzoeksgebied opgedeeld in kleinere subeenheden, de zogenaamde *land systems*, die een gebied of een groep van gebieden representeren met overeenkomstige landvormen (zoals heuvels of riviervalleien), bodems en vegetatie (CSIRO 1963). Elk land system (bijvoorbeeld een duinenlandschap) is onderzocht op een vooraf gestelde set van mogelijke kwaliteiten, zoals textuur, bodemtype en stenigheid van de bovengrond. De resultaten zijn in het derde hoofdstuk van dit proefschrift uitgewerkt.

Het vierde hoofdstuk beschrijft de landgebruikstypen in Midden- en Zuid-Italië, zoals deze volgens Forni (1990) gereconstrueerd kunnen worden voor de drie onderzoeksperiodes (Bronstijd, IJzertijd en Archaische/Romeinse Tijd). Forni heeft deze reconstructie gemaakt aan de hand van gevonden ploegen of delen ervan (de oudste in Italië dateert van 2000 jaar voor Chr.), fossiele ploegsporen en landgebruikstypen, die staan afgebeeld op potten of wanden in grotten. Hij heeft zich uitdrukkelijk niet alleen gebaseerd op oude literaire gegevens. Voor elke onderzoeksperiode zijn de naar grote waarschijnlijkheid verbouwde gewassen en de gebruikte landbouwtechnieken uitvoerig beschreven, inclusief de eisen die zij stelden aan de grond en/of het landschap.

Het vergelijken van alle gegevens, die enerzijds afkomstig zijn uit het landschapsonderzoek (alle landschapskarakteristieken) en anderzijds uit het archeologische/historische onderzoek (alle agrarisch/technologische data) werd vergemakkelijkt door het computerprogramma ALES (Rossiter 19..?). Na het invoeren van bodemgenoemde gegevens kan met een eenvoudige handeling de geschiktheid van een bepaalde landvorm voor een bepaald landgebruikstype berekend worden. Hierbij is onderscheid gemaakt tussen *geschikt*, *matig geschikt* en *ongeschikt*.

De geschiktheid van elke landform voor een bepaald type landbouw voor een bepaalde archeologische periode is gevisualiseerd op zogenaamde geschiktheidskaarten. Deze kaarten zijn getoetst aan de hand van huidige landgebruikskaarten (paragraaf 5.6) en pollen analytische data (hoofdstuk 6). Door de analyse van stuifmeel van drie venige locaties in de Agro Pontino, was het mogelijk per periode diverse typen van landgebruik (zoals graanverbouw of olijf cultivatie) en antropogene beïnvloeding op het landschap (zoals ontbossing) te kunnen onderscheiden. In het laatste hoofdstuk zijn de palynologische data getoetst aan de resultaten uit de archaeologische land evaluatie.